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ABSTRACT

Recent studies have documented a decline in academic performance and motivation as students move from elementary to middle level schools. This paper expands these studies in three ways: (1) by examining the classroom-level differences among middle school students' motivation to see if motivational constructs vary by classroom; (2) by exploring the specific within-classroom factors that affect early adolescents' motivation in mathematics and science; and (3) by using Hierarchical Linear Modeling (HLM) which is a multilevel technique. The 673 students in the study came from two middle schools in a largely blue collar community--most of the students were white. Participants completed the Patterns of Adaptive Learning Survey as well as questionnaires pertaining to specific academic subjects. All teachers filled out questionnaires assessing their pedagogical beliefs, instructional practices, and perceptions of the school culture. Results indicate that math teachers had a significant effect on their students' self-concept of ability. Likewise, science teachers who used ability-focused instructional practices, had students with lower measures of "learning focus" toward science than teachers who did not publicly acknowledge test scores or grades. Similar investigations are advocated for the later middle school and high school levels. Eight tables provide statistical summaries. (RJM)

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A Multilevel Model of Adolescents' Motivation and Strategy Use in Academic Domains

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Introduction

In recent years, several studies have documented a decline in academic performance and motivation as students move from elementary to middle level schools (Eccles & Midgley, 1989; Harter, Whitesell, & Kowalski, 1992; Simmons & Blyth, 1987; Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991). This decline may predict serious behavioral problems later in adolescence, including failure and dropping out of school (Carnegie, 1989). We believe that a variety of in school structures may be largely responsible for this decline.

Several related reasons have been suggested for this change in motivation. Some researchers have found that the practices and beliefs of middle school teachers foster student learning and motivation less at the middle school level than at the elementary school level (Midgley, Feldlaufer, & Eccles, 1989). Others suggest that the policies and practices of middle level schools define the goals of student learning in ways that emphasize competition, relative ability, and grades, rather than effort, creativity, and improvement (Maehr & Midgley, 1991; Midgley, in press). Research linking perceived school and classroom goals to student motivation (e.g., Ames & Archer, 1988; Maehr & Fyans, 1989) suggests that students who are particularly sensitive to "grades" and competitive learning environments may flounder in typical middle school settings.

Other research suggests that the motivation of early adolescents' differs by academic domain (Stodolsky, Salk, & Glasessner, 1991; Young, Arbreton, & Midgley, 1992; Wolters, Elder, & Anderman, 1993; Midgley et al, 1989). During the transition to middle school, students experience increased exposure to departmentalized instruction. Consequently, when studying adolescents' achievement related beliefs and goals, it is important to examine such variables within distinct academic domains.

The present paper expands previous work in three ways: (1) we use a sample of middle school students, and examine the classroom-level differences in student motivation, in order to see if motivational constructs vary by classroom; (2) we examine the specific within-classroom factors that affect early adolescents' motivation in mathematics and science, and (3) we use Hierarchical Linear Modeling, or "HLM" (Bryk, Raudenbush, Seltzer, & Congdon, 1989), which is a multilevel technique.

Most studies of student motivation in classrooms use ordinary least squares (OLS) type analyses. These analyses often are appropriate and have provided a solid research base. However, many fail to explain the unique effects of having a particular teacher and being exposed to particular instructional practices. Mult'level techniques such as HLM allow the researcher to examine the relative effects of both student *and* classroom level factors on cognitive and motivational outcomes.

Method

Sample

The students in this study come from two middle schools in a largely blue collar community near a major midwestern city. About 25% of the students in the school district qualify for free or reduced fee lunches. The majority of the students are white, with 16.9% of the students African-American. The sample consists of 673 students in grades six and seven, for which 77% of the students received parental permission to participate.

Procedure

Students completed the Patterns of Adaptive Learning Survey (PALS; Midgley & Maehr, 1990). In addition, all students completed questionnaires pertaining to specific academic subjects in those classrooms. For example, the mathematics survey was administered in the students' mathematics classrooms.[1] In addition, all teachers completed questionnaires assessing their pedagogical beliefs, instructional practices, and perceptions of the school culture. Factor analysis guided the construction of scales measuring students' goal orientations (mastery and performance), self-efficacy, self-concept of ability, expectancy, value, and cognitive strategy usage.

Results

Preliminary Analyses

Hierarchical linear techniques examine the percentage of variance between specific groups. In this study, classrooms were the group-level variable of interest. We ran fully unconditional analyses of variance using HLM in four subject areas (mathematics, science, English, and social studies) to determine whether motivational constructs varied significantly by classroom. In English and social studies, there was little variance between classrooms; consequently, we decided not to use hierarchical linear modeling for these domains. This in itself is striking, particular given the very low variance percentages in social studies (all were below 4%). In math (Table 5), we found that self-concept of ability in math varied 8.9%, so we used HLM to examine the within and between classroom variation in this variable. Similarly in science (Table 7), we found that learning-focus varied 8.31% between classrooms and we undertook a full model in science as well.

[1] Questionnaires were administered in English, mathematics, science, and social studies.

Second Stage Analyses

Math

Table 6 presents the results of the full hierarchical linear model in math. Because self-concept of ability in math was the construct with the highest variation between classrooms, this became the dependent variable in the full model. The gamma values can be treated roughly as b values (unstandardized regression coefficients) in a regular hierarchical regression. Results revealed that two teacher-level variables were significant in this model, *teacher's belief in the modifiability of intelligence* ($p<.08$), [2] which was modeled on the dependent variable, and *gender of teacher* ($p<.06$), which was modeled on students' math expectancy.

These teacher-level findings indicate that if a student has a teacher who believes that intelligence is modifiable (Gamma=-.136), that student will have a lower math self-concept of ability. In addition, one other student level variable had a strong relationship with math self-concept of ability - math expectancy. The second teacher-level finding in math indicates that if a student has a female math teacher, the relationship between the math expectancy slope and math self concept of ability is lower.

With respect to the student level variables, we found a positive relationship between learning focus and self-concept of ability, so that students who have more learning focused goals are also likely to have higher self-concept of ability in math. We also found a positive relationship between math ability focus and self-concept of ability as well as a negative relationship between deep strategy use in math and self-concept of ability. Both of these relationships were weak, though significant.

Other student-level variables indicate that there is a strong positive relationship between expectancies for success in math and math self-concept of ability. Also, there is a mild positive relationship between math self-efficacy and self-concept of ability in math. This means that if a student expects to do well in math, s/he is likely to have a strong self-concept of ability in this subject. Similarly, if a student feels s/he can do the work in math, s/he is more likely to feel competent in math.

Science

The results for science learning focus were as expected (see Table 8). In this model, the only teacher level variable that was significant was *ability-focused instructional practices*. This means that if a student is in a class where the teacher uses ability-focused instructional practices, the student is less likely to be learning-focused. This finding corroborates the work of Ames & Archer (1988), who suggest ability or task-focused instructional practices influence students'

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[2] In HLM analyses, probability levels of $p<.10$ often are considered as acceptable significance levels, since it is difficult to obtain significant group-level differences, particularly when the number of groups (classrooms, in the present example) is low.

personal goals. The other student level variables were significant in the expected directions, such as ability-focus in science being negatively related to learning focus, deep strategy use in science being moderately positively related to learning focus, and valuing science being positively related to learning focus, though weakly.

Discussion

We were interested in exploring the relationships between student-level motivational characteristics and the teacher-level characteristics which might affect student motivation. We predicted that there would be some content area differences in student motivation and that these might be attributed to classroom practices of teachers in that content area. Hierarchical linear modeling techniques have allowed us to explore these questions first by examining the amount of variance between classrooms for a particular content-specific construct, and second, by mapping teacher-level characteristics onto this variation.

We performed preliminary analyses for four content areas - English, social studies, math, and science. Results of these analyses revealed that social studies (Table 4) had the least percentage of between classroom variance across constructs. This indicates that the students are more likely to vary as a function of individual differences, rather than as a function of classroom context. Social studies is often a new area of study beginning in the sixth grade (as we know it is for the students in this sample) and students may be just beginning to develop a motivational schema with which to work in this content area. To do this, they would need to be exposed to the content - material to be learned, dominant instructional formats, etc.

Similarly, English showed little variation between classrooms on the cognitive and motivational constructs we studied, though there was higher percentage of variance than in social studies. One interpretation for this finding is that English and mathematics classes in this sample are ability grouped, which may account for this lack of variations.

In contrast, there was an 8.9% variation between math classrooms on self-concept of ability. In itself, this indicates that the teacher, and hence the instruction, has an effect on students' self-concept of ability. The full hierarchical model revealed that this effect was in part driven by the teachers' belief in the modifiability of intelligence. Surprisingly though, students whose teacher believed that intelligence is modifiable had *lower* self-concept of ability in math. One interpretation of this is that teachers who believe that intelligence is modifiable may be using instructional practices or have classroom policies which do not allow students to develop a static notion of self-concept of ability in math. However, further examination of this finding is necessary.

Other support for this interpretation comes from the student-level findings. We would have predicted that the relationships we found would be opposite to the actual results. Student ability focus in math was positively related to self-concept of ability in math and deep strategy use in math was negatively related to self-concept of ability. This seems to indicate that students who hold ability focused goals or students who do not use deep processing strategies have a slightly higher self-concept of ability. While this contrasts with the work of some other researchers (e.g., Ames & Archer, 1988; Dweck & Leggett, 1988), little work has been done with early adolescents. Consequently, it is quite plausible that middle school students' conceptions of and definitions for learning may be quite different than those of elementary school children. For example, Midgley, Anderman, & Hicks (in press) found that middle school students and teachers are more ability focused and less task-focused than elementary students and teachers. Consequently, early adolescents may develop the belief that ability and competition are conducive to doing well in school, and consequently, the more ability-focused students may believe that they have higher self-concepts.

Between science classrooms, there was an 8.31% variation in learning focus, meaning that the teacher has an effect on students' wanting to learn because they are interested in the material or because they want to know more about this content area. The full hierarchical model revealed that students who have a teacher who uses ability-focused instructional practices tend to be significantly less learning-focused. This relationship is consistent with other research on goal theory (Ames, 1990; Anderman, Urdan, & Midgley, 1992). Other student-level characteristics show relationships to learning focus in science that are also consistent with the work in goal theory.

There are several implications to this study. The first is that math teachers in this sample had a significant effect on their students' self-concept of ability. This is of concern because self-concept of ability is an important motivational characteristic, particularly in math. This in turn may effect students future choices in math courses as well as careers. Given the finding regarding the gender of the teacher, it may be important to employ students' gender as a predictor in future analyses, although research suggests that in mathematics, gender differences may be more attributable to stereotypic information, rather than actual ability (see Jacobs & Eccles, 1992).

Second, science teachers' who use ability focused instructional practices tend to have students with lower measures of "learning focus" toward science. It would be important for science teachers to consider the long term effects of such practices as publicly acknlowedging test scores or grades. Discontinuing or at least de-emphasizing such ability focused practices might have a positive impact on students' motivation to learn for the sake of learning. It will be important to further explore specifically the nature of ability-focused instructional practices.

In conclusion, we advocate future investigations of this type at the later middle school and high school level. The data for this study were taken for sixth and seventh graders who were in their first two years of departmentalized instruction. We would expect that the results of the present study would be stronger as students progressed through the various levels of instruction where they encountered several different content areas. The results of this work provide an argument for the transmission of messages and goals which have significant effect on students' motivational characteristics.

Table 1

Zero-Order Correlations for Mathematics

Variable	1	2	3	4	5	6	7	8
1. Ability Focus	1.00							
2. Deep Strategies	-.22	1.00						
3. Learning Focus	-.32	.65	1.00					
4. Self Concept of Ability	-.11	.22	.35	1.00				
5. Self-Efficacy	-.24	.29	.36	.51	1.00			
6. Surface Strategies	.46	-.31	-.37	-.31	-.45	1.00		
7. Value	-.20	.36	.35	.31	.21	-.23	1.00	
8. Expectancy	-.21	.30	.37	.74	.51	-.34	.40	1.00

Note. p<.01 for all values

Table 2

Zero-Order Correlations for Science

Variable	1	2	3	4	5	6	7	8
1. Ability Focus	1.00							
2. Deep Strategies	-.32	1.00						
3. Learning Focus	-.42	.73	1.00					
4. Self Concept of Ability	-.22	.33	.39	1.00				
5. Self-Efficacy	-.28	.38	.42	.55	1.00			
6. Surface Strategies	.46	-.39	-.40	-.30	-.42	1.00		
7. Value	-.26	.47	.48	.45	.31	-.27	1.00	
8. Expectancy	-.22	.39	.45	.81	.55	-.32	.57	1.00

Note. p<.01 for all values

Table 3
Percentage of Variance in Motivational Constructs Between Classrooms for English

Predictor	% Variance	Chi Square	# Classes	Tau	Sigma 2
English Self Concept of Ability	5.22%	54.056***	24	0.05277	0.958
English Learning Focus	5.73%	57.156***	25	0.0576	0.949
English Ability Focus	4.41%	55.094***	25	0.04413	1.000
English Self Efficacy	6.33%	63.141***	25	0.06313	0.997
English Surface Strategies	6.58%	75.146***	25	0.06603	0.938
English Deep Strategies	5.13%	57.840***	25	0.05126	0.948
English Expectancy	2.06%	37.152*	25	0.02075	0.986
English Value	0.87%	25.418	25	0.00866	0.987

Table 4
Percentage of Variance in Motivational Constructs Between Classrooms for Social Studies

Predictor	% Variance	Chi Square	# Classes	Tau	Sigma 2
Social Studies Self Concept of Ability	3.76%	48.781**	28	0.03836	0.983
Social Studies Learning Focus	4.09%	52.049**	28	0.4205	0.986
Social Studies Ability Focus	3.63%	47.521**	28	0.03702	0.984
Social Studies Self Efficacy	2.52%	41.942*	28	0.02557	0.989
Social Studies Surface Strategies	0.11%	25.786	27	0.00107	1.020
Social Studies Deep Strategies	2.21%	42.161*	28	0.02283	1.013
Social Studies Expectancy	2.63%	41.952*	28	0.02681	0.994
Social Studies Value	0.67%	30.588	28	0.00679	1.008

$^{+}p<.06$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

Table 5
Percentage of Variance in Motivational Constructs Between Classrooms for Math

Predictor	% Variance	Chi Square	# Classes	Tau	Sigma 2
Math Self-Concept of Ability	8.90%	75.74***	27	0.9099	0.931
Math Learning Focus	0.11%	42.49*	27	0.0011	0.994
Math Ability Focus	1.12%	38.30†	27	0.0112	0.991
Math Self Efficacy	2.95%	43.11**	27	0.0293	0.965
Math Surface Strategies	4.83%	60.37***	27	0.0488	0.960
Math Deep Strategies	3.86%	46.57**	26	0.0392	0.976
Math Expectancy	6.82%	71.85***	27	0.0686	0.938
Math Value	0.76%	24.62	27	0.0076	0.997

Table 6
Full Hierarchical Linear Model for Variance in Mathematics Self-Concept of Ability

PREDICTOR	GAMMA	Notes
Base Coefficient	0.001	
Modifiability of Intelligence Modelled on Base	-0.136§	
Math Learning Focus	0.159***	Fixed Parameter
Math Ability Focus	0.089**	Fixed Parameter
Math Self Efficacy	0.182***	Fixed Parameter
Math Deep Strategy Use	-0.089*	Fixed Parameter
Math Expectancy	0.788***	
Gender of Teacher Modelled on Expectancy	-0.129†	

§p<.08, † p<.06, * p<.05, ** p<.01, *** p<.001

Table 7
Percentage of Variance in Motivational Constructs Between Classrooms for Science

Predictor	% Variance	Chi Square	# Classes	Tau	Sigma 2
Science Self-Concept of Ability	7.64%	64.688***	24	0.075	0.907
Science Learning Focus	8.31%	67.868***	24	0.085	0.933
Science Ability Focus	5.19%	52.729***	24	0.052	0.951
Science Self Efficacy	6.84%	59.345***	24	0.067	0.907
Science Surface Strategies	1.36%	31.146	24	0.014	0.983
Science Deep Strategies	6.20%	56.245***	24	0.063	0.953
Science Expectancy	5.00%	52.318***	24	0.045	0.903
Science Value	5.76%	55.931***	24	0.057	0.928

Table 8
Full Hierarchical Linear Model for Variance in Science Learning Focus

PREDICTOR	GAMMA	Notes
Base Coefficicent	0.006	
Ability-focused instructional practices modeled on base	-0.125**	
Science Ability Focus	-0.158***	Fixed Parameter
Science Self Efficacy	0.089**	Fixed Parameter
Science Deep Strategies	0.564***	Fixed Parameter
Science Value	0.124***	Fixed Parameter
Science Self-Concept of Ability	0.072*	Fixed Parameter

§p<.08, † p<.06, * p<.05, ** p<.01, *** p<.001

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